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(54) **METHOD AND APPARATUS FOR
CONSERVATIVE LINK SELECTION**

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(57) **ABSTRACT**

(*) **Notice:** Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

A method is described for path selection in communications networks with multiple QoS metrics. This method takes an additive metric (say, cost) as a path minimization target and a concave metric (say, bandwidth) as a minimum requirement for each link. A potential objective is to find a path between a source node and a destination node in a communications network such that the bandwidth of each link in the path exceeds a bandwidth requirement and the cost of the path is minimized. The method eliminates from consideration those links whose available bandwidth does not exceed a required bandwidth. The method then reassigns the cost of those links whose available bandwidth does not exceed a function of the required bandwidth. A path from the source node to the destination node is then selected, using only links still under consideration, corresponding to a path wherein cost is minimized.

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(52) **U.S. Cl.** 709/241

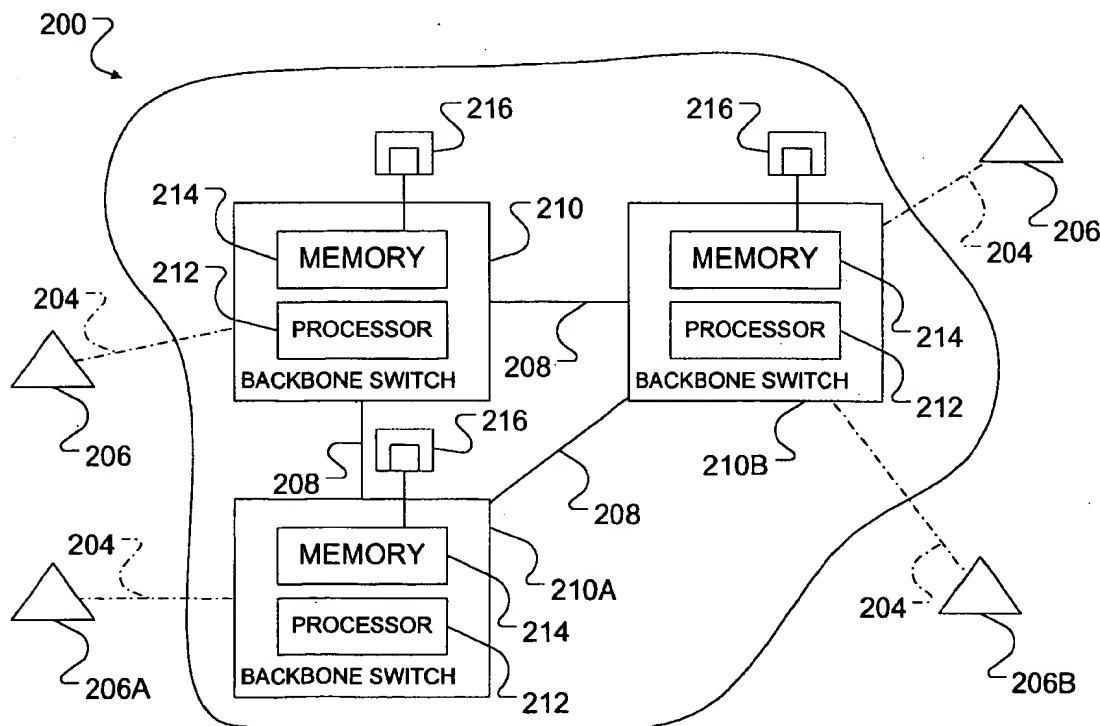
(58) **Field of Search** 709/200-241

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19 Claims, 8 Drawing Sheets



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TITLE: Method and apparatus for conservative link selection

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Detailed Description Text - DETX (2):

In a network having nodes and links between the nodes, we define a concave metric $A_{\text{sub}}(i, j)$ and an additive metric $C(i, j)$ for the link (i, j) between each pair of nodes i and j and two specified nodes, s (the source node) and e (the end or destination node). By way of example, the additive metric, $C(i, j)$, may be the cost of the link (i, j) and the concave metric, $A_{\text{sub}}(i, j)$, may be the available bandwidth of the link (i, j) . The objective is to find a path $p(s, e)$ between the source node and the end node such that at least a minimum amount of bandwidth is available along the path and the cost of the path (which is the sum of link costs over the path) is minimized.

Detailed Description Text - DETX (3):

Referring to FIG. 1, which models a communication system 100 as a graph of nodes, the link (i, j) between each pair of nodes is shown to have an associated available bandwidth and cost.

Detailed Description Text - DETX (7):

Illustrated in FIG. 4 is a method for considering available bandwidth when performing path selection in an embodiment of this invention. For a particular link (i, j) , if the required bandwidth is greater than the

available bandwidth
 (i.e., $R_{sub.bw} > A_{sub.bw}(i, j)$) the link is eliminated
 from the graph
 (step 402). Otherwise (i.e., where $R_{sub.bw} \leq A_{sub.bw}(i, j)$), if a
 specified inflated value of the required bandwidth is greater
 than the
 available bandwidth, the cost of the link may be reassigned
 to a higher value.
 The value of $R_{sub.bw}$ is inflated by taking a function of
 same and comparing
 this with $A_{sub.bw}(i, j)$. Thus, if $f(R_{sub.bw}) > A_{sub.bw}(i, j)$, the cost
 of link (i, j) is reassigned. For example, the cost
 reassignment could be $C(i, j) = C(i, j) + k * C_{sub.MAX}$, where parameter k may be determined
 by simulation and
 where $C_{sub.MAX}$ is the cost of the greatest cost link in the
 graph. Function
 $f(R_{sub.bw})$ may be defined as follows: ##EQU1##